SOLUTIA

Solutions for a better life.

Solutia Inc.
575 Maryville Centre Drive
St. Louis, Missouri 63141

P.O. Box 66760
St. Louis, Missouri 63166-6760
Tel: 314-674-1000

July 31, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Disturbed Area Stormwater Treatment System Design
Sauget Area 2 Interim Groundwater Remedy

Dear Mr. Fayoumi,

Enclosed is the stormwater treatment system design for runoff from areas disturbed during construction of the Sauget Area 2 Interim Groundwater Remedy barrier wall. The treatment system consists of two 250,000 gallon stormwater collection tanks, a three-stage filtration unit and two GAC beds operated in lead/lag mode. Treated stormwater will be routed to surface drainage. This system will be operational by the start of barrier wall construction.

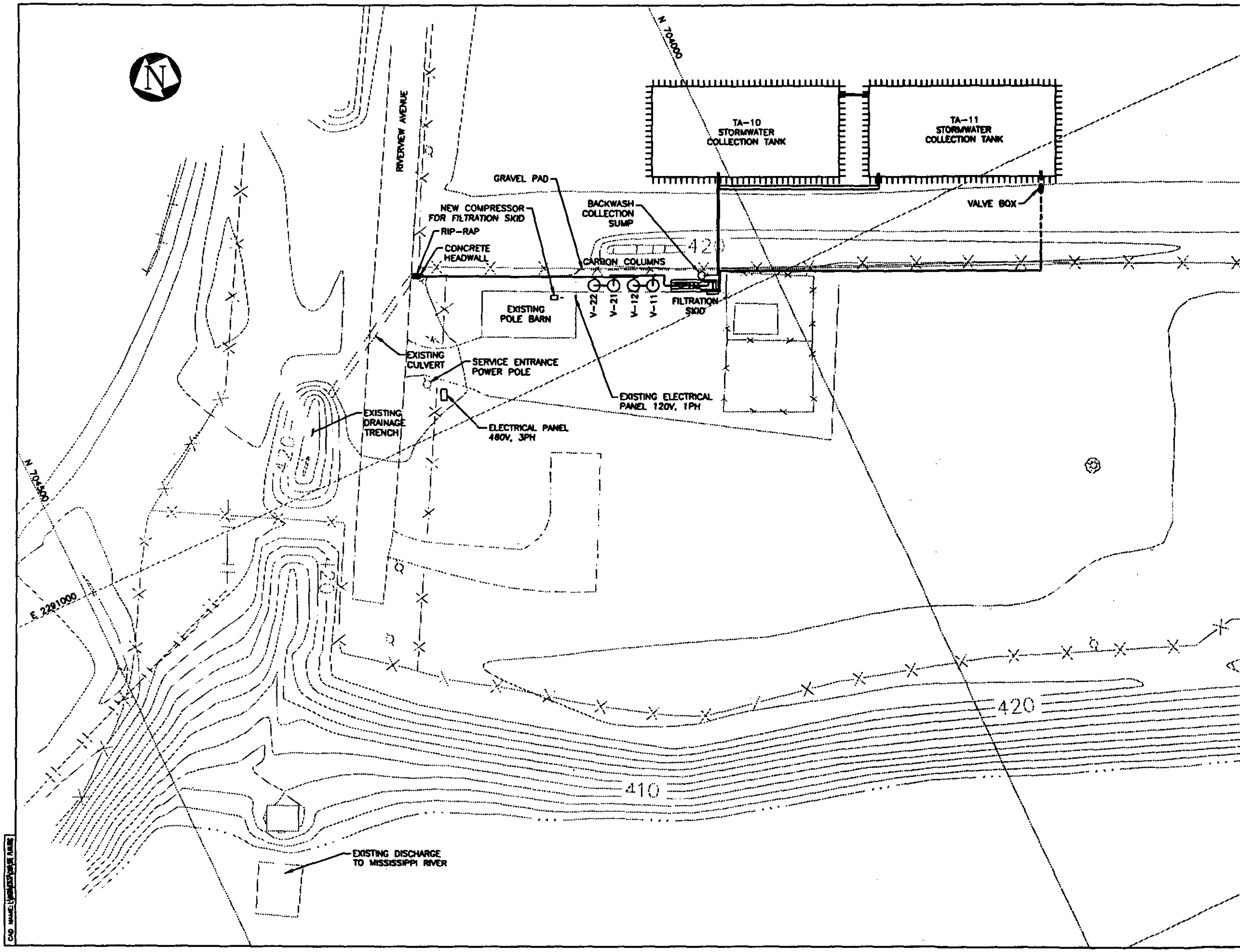
Please call me at 314-674-6768 if you have any questions.

Sincerely,

Gary Vandiver /pk

Gary Vandiver
Project Coordinator
Solutia Inc.

cc: Sandra Bron – IEPA
Steven Acree – USEPA
Ken Bardo – USEPA
Mike Coffey - USF&W
Tim Gouger - USACE
Peter Barrett – CH2M Hill
Linda Tape – Husch & Eppenberger
Gary Vandiver - Solutia
Richard Williams - Solutia
Bruce Yare - Solutia



REV	DESCRIPTION	DATE	APPR. BY	MADE BY
B	FOR BIDDING	7/28/03	CSR	WWL
A	FOR OWNER REVIEW	7/21/03	CSR	WWL

REVISIONS

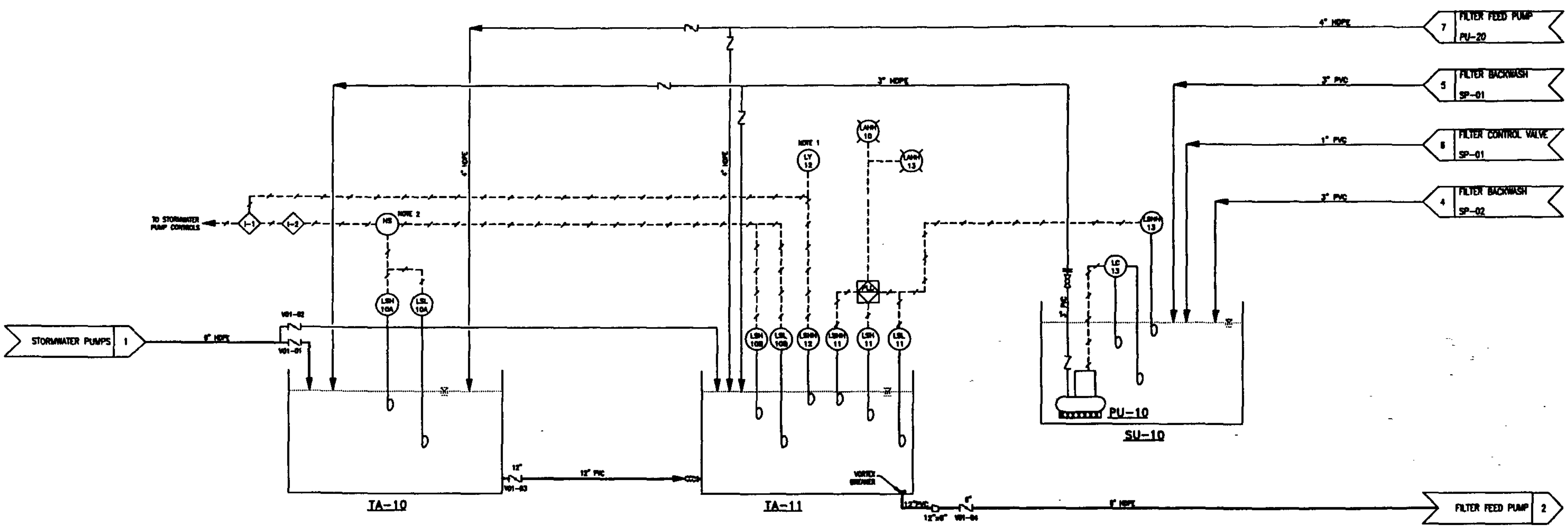
	BY	DATE		BY	DATE
DRAWN	WWL	7/14/03	APPR.	CSR	7/18/03
CHKD.	SGB	7/18/03			
SCALE: 1:30					

THE *ADVENT* GROUP, INC.
Nashville, Tennessee

STORMWATER TREATMENT SYSTEM
GENERAL ARRANGEMENT

SOLUTIA KRUMRICH
SAUGET, ILLINOIS

CONTRACT NO.	DRAWING NO.	REV.
03637	GA-01	B



PU-10
BACKWASH COLLECTION PUMP
150 GPM @ 25' TDH
2 HP, 1,750 RPM
460V 3PH
MAT'L OF CONST: CI

SU-10
BACKWASH COLLECTION SUMP
DIMENSION: 5'ø x 5'-0" H
OPERATING CAPACITY: 360 GAL.
MAT'L OF CONST: PE

TA-10/TA-11
STORMWATER COLLECTION TANK
DIMENSION: 60'-6" x 124'-3" x 4'-9"
OPERATING CAPACITY: 253,000 GAL.
MAT'L OF CONST: STEEL WALL PANEL WITH 45 MIL. PP LINER

NOTES:

1. ALARM INPUT TO AUTODIALER.
2. OPERATOR SHALL SELECT TANK TA-10 OR TA-11 TO PUMP INTO BEFORE STARTING STORMWATER PUMPS.

INTERLOCKS:

I-1 STORMWATER PUMPS TO DE-ENERGIZE AT TA-10 LSH-10A, TA-11 LSH-10B, OR TA-11 LSHH-12.
I-2 STORMWATER PUMPS TO ENERGIZE AT TA-10 LSL-10A OR TA-11 LSL-10B.

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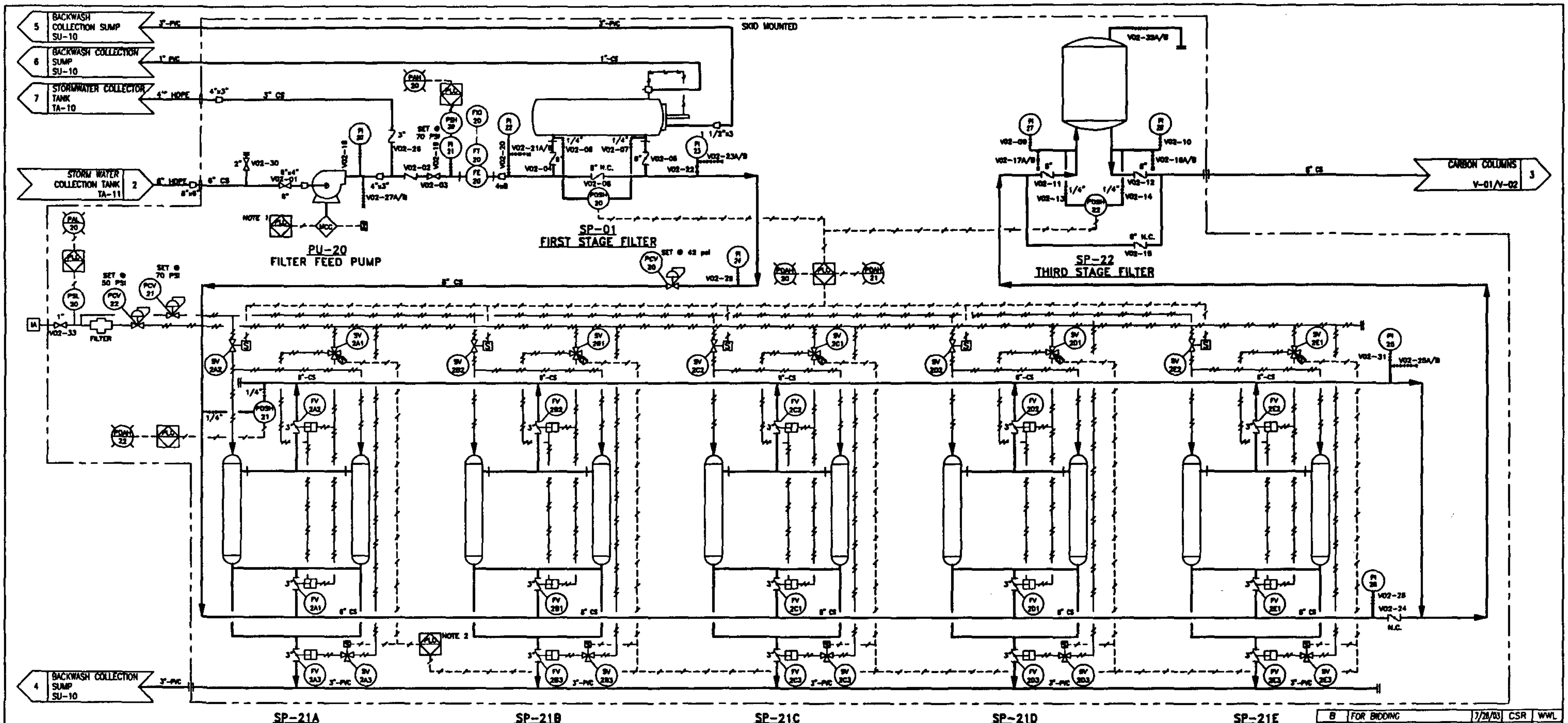
CHKD.	SGB	7/18/03			
SCALE: N.T.S.					

THE ADVENT GROUP, INC.
Nashville, Tennessee

PIPING AND INSTRUMENTATION DIAGRAM
STORMWATER STORAGE

SOLUTIA KRUMRICH
SAUGET, ILLINOIS

CONTRACT NO.	DRAWING NO.	REV.
03637	PID-01	B



SP-21A/B/C/D/E
SECOND STAGE FILTERS

NOTES:

1. PUMP ACTIVATION IS INTERLOCKED WITH LSH-11 LOCATED IN THE STORMWATER COLLECTION TANK (TA-11). PUMP DEACTIVATION IS INTERLOCKED WITH LSL-11 LOCATED IN THE STORMWATER COLLECTION TANK (TA-11), LSHH-11 LOCATED IN THE BACKWASH COLLECTION SUMP (SU-10), AND PSH-20 LOCATED AT PU-07 DISCHARGE.
2. BACKWASH SEQUENCED, ONLY ONE DUAL UNIT OFF-LINE FOR CLEANING.
3. PLC TO GENERATE ALARM OUTPUT FOR THE FOLLOWING CONDITIONS:
   - -HIGH HIGH LEVEL TANK TA-11 (LSHH-11)
   - -HIGH DIFFERENTIAL PRESSURE FILTER 1 (PDSH-20)
   - -FILTER 2 NEEDS CLEANING
   - -HIGH DIFFERENTIAL PRESSURE FILTER 3 (PDSH-22)
   - -HIGH HIGH LEVEL BACKWASH COLLECTION SUMP (LSHH-13)
   - -HIGH PRESSURE FILTER FEED PUMP (PSH-20)
   - -LOW PRESSURE INSTRUMENT AIR (PSL-20)
   - -PRESSURE ALARMS (PDAH-20/21/22, PAH-20, PAL-20) TO AUTODIALER.

LAST VALVE NO.: V02-33

PU-20
FILTER FEED PUMP
400 GPM @ 140' TDH
25 HP, 3,500 RPM
460 V 3 PH
MAT'L OF CONST: DI

SP-20
FIRST STAGE FILTER
8"-400 GPM
40 MICRON FILTER
AUTOMATIC SELF CLEANING
MAT'L OF CONST: CS

SP-21A/B/C/D/E
SECOND STAGE FILTERS
5 DUAL UNITS
10 HOUSINGS, 50 GPM EACH
10 MICRON BAG FILTER
AUTOMATIC BACKWASH
MAT'L OF CONST: CS

SP-22
THIRD STAGE FILTER
400 GPM
36"ø VESSEL
12~30" L FILTERS
5 MICRON PLEATED BAG FILTER
MAT'L OF CONST: CS

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REVISIONS

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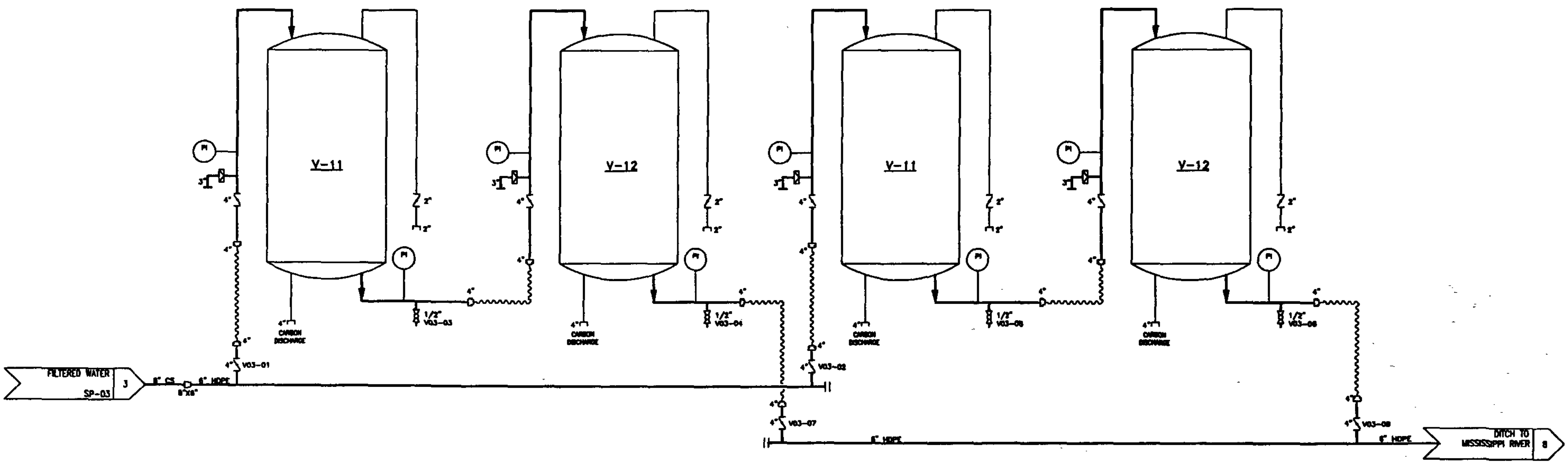
CHKD.	SGB	7/18/03			
SCALE	N.T.S.				

THE ADVENT GROUP, INC.
Nashville, Tennessee

PIPING AND INSTRUMENTATION DIAGRAM
STORMWATER FILTRATION SKID ASSEMBLY

SOLUTIA KRUMRICH
SAUGET, ILLINOIS

CONTRACT NO.	DRAWING NO.	REV.
03637	PID-02	B



V-11/V-12
MOBILE ADSORBER UNIT
DIAMETER: 7'-10"
CARBON CAPACITY: 12,000 lb
FLOW RATE: TO 225 GPM
MANUFACTURER: CALGON CARBON CORP.

V-21/V-22
MOBILE ADSORBER UNIT
DIAMETER: 7'-10"
CARBON CAPACITY: 12,000 lb
FLOW RATE: TO 225 GPM
MANUFACTURER: CALGON CARBON CORP.

REV	DESCRIPTION	DATE	APPR. BY	MADE BY
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CHKD.	SGB	7/18/03			
SCALE: N.T.S.					

THE ADVENT GROUP, INC.
Nashville, Tennessee

PIPING AND INSTRUMENTATION DIAGRAM
CARBON TREATMENT

SOLUTIA KRUMRICH
SAUGET, ILLINOIS

CONTRACT NO.	DRAWING NO.	REV.
03637	PID-03	B

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July 31, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Groundwater Treatment Contingency Plan Cost Estimate
Sauget Area 2 Interim Groundwater Remedy

Dear Mr. Fayoumi,

This letter is in response to your July 22, 2003 request for an estimate of the cost to implement the Groundwater Treatment System Contingency Plan.

Enclosed with this letter is the technical memorandum Groundwater Treatment System GAC Treatment System Cost Estimate which addresses your request.

Please call me at 314-674-6768 if you have any questions.

Sincerely,

Gary Vandiver /plc

Gary Vandiver
Project Coordinator
Solutia Inc.

cc: Sandra Bron – IEPA	Linda Tape – Husch & Eppenberger
Steven Acree – USEPA	Gary Vandiver - Solutia
Ken Bardo – USEPA	Richard Williams - Solutia
Mike Coffey - USF&W	Bruce Yare - Solutia
Tim Gouger - USACE	
Peter Barrett – CH2M Hill	

Yare, Bruce S

From: Janet Egli [j.egli@adventgrp.com]

Sent: Tuesday, July 29, 2003 11:16 AM

To: Yare, Bruce S

Cc: Williams, Richard S; Scott Reece; Carl Adams; Pat Campbell

Subject: Groundwater Treatment Contingency Plan Cost Estimate

Bruce,

The attached pdf file presents the updated cost estimates for the GAC treatment system proposed in the Groundwater Treatment Contingency Plan. The system has been designed for 600 gpm average flow, 1,000 gpm max. Capital costs do not include site prep (concrete pad or gravel) or oxidation equipment. The operating costs shown reflect the usage rate based on results of the treatability study.

Please contact us if you have any questions or need additional information.

Best regards,
Janet

Janet Egli, P.E.
The ADVENT Group, Inc.
201 Summit View Drive
Brentwood, TN 37027
TEL: 615-377-4775 ext 158
FAX: 615-377-4976

THE ADVENT GROUP, INC.

MEMORANDUM

TO:	Bruce Yare, Solutia
FROM:	Scott Reece and Janet Egli
DATE:	July 29, 2003
SUBJECT:	Groundwater Treatment Contingency Plan GAC Treatment System Cost Estimate ADVENT Project 02691
CC:	Richard Williams, Solutia; Carl Adams and Patrick Campbell, ADVENT

Budgetary estimates were developed for the capital equipment costs and weekly operating costs associated with the installation and operation of the GAC treatment system proposed in the Groundwater Treatment Contingency Plan. The development of the capital cost for the GAC treatment system is summarized in Table 1. This system was designed to treat 1,000 gpm. A detailed description of the items included in the capital cost estimates, along with the basis for the estimated costs, is shown below:

- **Pumping and Storage.** Budgetary estimates are included for all of the following pieces of equipment: Backflush Supply Pump, Spray Water Pump, Trailer Dewatering Pump, and the Backflush Supply Tank. Costs for the three pumps reflect the estimated cost for the mechanical installation of each unit, but do not include any electrical hookup. These costs are based on capital equipment quotes from the local Goulds Pump representative, Tenncarva Machinery Company (Nashville, TN). The estimated cost for the Backflush Supply Tank is based on information in the Means Heavy Construction Cost Data Book[1] and includes installation of the unit, but does not include the foundation or site work. All piping associated with the pumping and storage equipment is included as a separate item within this estimate.

- **Backup Carbon Treatment System.** Budgetary estimates are provided for all of the activated carbon equipment located at each adsorber train. The estimate for each train includes purchasing two adsorption columns, the valve manifold, all associated valves, piping and pressure gauges. The estimated cost reflects the price for installation, along with the initial fill of virgin carbon in each adsorber, standard warranty, and start-up assistance based on Calgon Carbon's 10-ft diameter Dual Module Systems. All piping associated with connecting the valve manifold to the header system is included as a separate item within this estimate.

[1] R.S. Means Company, Inc. *Heavy Construction Cost Data, 12th Annual Edition.* 1998: R.S. Means Co., Kingston, Massachusetts.

- **Compressed Air.** Costs for the Transfer Air Compressor include only the mechanical installation of the unit, but does not include any electrical hookup. This estimate is based on capital equipment quotes from the local Atlas Copco representative, Tenncarva Machinery Company (Nashville, TN).

- **Process Piping.** Based on information in the Means Heavy Construction Cost Data Book, a budgetary estimate was compiled for all of the process piping, fittings, and manual valves in the treatment train. This estimate includes piping for the backflush supply, backflush return, spray water, and trailer return water. Costs for hoses leading to adsorbers and piping connecting to the main pipeline from the groundwater wells to the treatment plant are included in this estimate.

- **Field Instrumentation.** Some field instrumentation is included independent of the vendor-supplied packages. This instrumentation includes a turbine meter to indicate flow to each carbon system, a high level alarm connected to a level control valve to maintain water depth in the Backflush Supply Tank, regulators to deliver desired air pressures for carbon transfer, and pressure gauges for each of the pump discharges. Purchase costs for these instruments are included in the cost estimate. These costs are based upon capital equipment quotes from Southeastern Automation Group, Inc. (Knoxville, TN).

- **Electrical.** The electrical costs include installation and wiring of field instrumentation. This also includes power connections for all three pumps and the air compressor.

- **Indirect Costs.** Allowances were included in the cost estimate for various indirect costs, typically estimated as a percentage of the total direct costs. These indirect costs include contractor indirect expenses (35%), contractor overhead and profit (25%), and detailed design engineering (15%). These percentages are based on industry norms, ADVENT's best engineering judgment, and prior estimating experience. The contractor indirect expenses include project management and supervision, safety supplies, contract guards services, temporary buildings and utilities materials and erection, small tools and construction supplies, travel and living expenses, bond premiums, communications and postage, utility charges, licenses and permits, field office supplies, construction equipment (e.g. vehicles, etc.), and equipment service labor and supplies.

- **Contingency.** A contingency allowance of 20% of the total project cost is included to cover any unforeseen costs, which may be incurred during construction and startup of the facility.

The estimated operating costs are based upon treating the design average flow of 600 gpm. Costs are calculated on a per week basis. These costs are presented in Table 2. Carbon replacement is the primary operating expense for this system. This expense is proportional to carbon usage rates based on the groundwater TOC data collected during the May 2003 pump test and an adsorptive capacity of 0.103 lb TOC/lb carbon observed during that test. A detailed description of the items included in the weekly operating cost estimate, along with the basis for the estimated costs, is shown below:

- **Electrical.** Electrical cost estimates are based upon power costs of $0.046 per kilowatt-hour. The pumps and compressors are anticipated to be in operations once every two days to replace the carbon in one of the eight columns.

- **Maintenance.** Maintenance costs are assumed to be 3 percent of the installed equipment cost, per year.

- **Labor.** Labor costs are based on having an operator present 28 hours per week for carbon transfer and sample collection while the treatment system is operating. A $40 per hour labor rate is used for these calculations. This rate includes costs for benefits, training, etc.

- **Laboratory.** Laboratory expenses are assumed to be $300 per week for weekly specific organic analyses (EPA 8270). Any monitoring for permit compliance would be in excess of this. On-site COD and TOC daily analyses of each column effluent are estimated to cost $420 per week.

- **Carbon.** Weekly operating expenses have been developed based on reactivated carbon used during the May 2003 pump test.

Based on the above, the budgetary capital cost associated with the installation of a GAC backup treatment system is $1.42 million. Projected weekly operating costs are $30,000. A list of assumptions used in developing these costs is provided in Table 3.

TABLE 1. GROUNDWATER TREATMENT CONTINGENCY PLAN
GAC TREATMENT SYSTEM CAPITAL COST ESTIMATE
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

PARAMETER	SIZE OF UNIT	DESCRIPTION	NUMBER OF UNITS	INSTALLED UNIT COST	TOTAL COST (ROUNDED)	REMARKS
PUMPING AND STORAGE						
Trailer Drain Pump	100 gpm, 3hp	For draining trailer water to column effluent	1	$5,000	$5,000	
Backflush Pump	225 gpm, 3hp	Centrifugal pump for carbon flush water w/ installed spare	1	$10,000	$10,000	(a)
Spray Water Pump	100 gpm, 7.5hp	Centrifugal pump for flushing carbon out of columns	1	$5,000	$5,000	
Backflush Storage Tank	12,000 gal	Carbon steel tank, insulated	1	$20,000	$20,000	(a)
Dual Carbon Columns	10 ft dia.	Includes initial carbon, 20,000 lbs each	4	$120,000	$480,000	(b)
Utility Air Compressor	85 scfm	For carbon transfer	1	$4,300	$4,300	(a)
TOTAL EQUIPMENT COSTS (rounded)					**$525,000**	
Piping		Includes pipes, flex hose, valves, fittings, and pipe testing			$108,000	
Field Instrumentation		Non-vendor supplied field instruments only			$15,000	
Electrical		Installation of instrumentation and wiring of equipment			$30,000	
Subtotal					**$153,000**	
TOTAL DIRECT COSTS					**$678,000**	
Indirect Costs	35%				$237,000	(c)
Contractor Overhead/Profit	25%				$170,000	(c)
Engineering	15%				$102,000	
Subtotal					**$509,000**	
TOTAL CAPITAL COSTS					**$1,187,000**	
Contingency	20%				$237,000	
TOTAL PROJECT COST					**$1,420,000**	

Notes:
(a) Mechanical installation only. Electrical and Piping installation costs listed separate.
(b) Unit cost includes initial carbon, valve manifold, vendor instrumentation, and freight.
(c) Costs are based on total direct costs.

TABLE 2. GROUNDWATER TREATMENT CONTINGENCY PLAN
GAC TREATMENT SYSTEM WEEKLY OPERATING COSTS USING REACTIVATED CARBON (a)
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

PARAMETER	ELECTRICAL		MAINTENANCE	OPERATING LABOR		LABORATORY COSTS	CARBON	TOTAL O&M (ROUNDED)
	(kW)	($/wk)	($/wk)	(operators)	($/wk)	($/wk)	($/wk)	($/wk)
ACTIVATED CARBON SYSTEM								
Columns			$300	1.00	$0	$0	$28,000	$28,300
Backflush Pump	7	$2	$6	0.00	$0	$0	$0	$10
Subtotal	7	$2	$306	1.00	$0	$0	$28,000	$29,000
CARBON TRANSFER SYSTEM								
Spray Pump	15	$3	$3	0.00	$0	$0	$0	$6
Trailer Dewatering Pump	7	$5	$3	0.00	$0	$0	$0	$8
Air Compressor	22	$8	$3	0.00	$0	$0	$0	$11
Subtotal	30	$16	$9	0.00	$0	$0	$0	$30
BACKFLUSH STORAGE								
Tank	0	$0	$12	0.00	$0	$0	$0	$12
ANALYSIS								
By Operator	0	$0	$0	0.00	$0	$420	$0	$0
Outside Lab	0	$0	$0	0.00	$0	$300	$0	$300
Subtotal	0	$0	$0	0.00	$0	$720	$0	$720
TOTAL WEEKLY COST		**$100**	**$400**		**$0**	**$800**	**$28,000**	**$29,800**
COST PER DAY		**$14**	**$57**		**$0**	**$114**	**$4,000**	**$4,257**
COST PER YEAR		**$5,200**	**$20,800**		**$0**	**$41,600**	**$1,456,000**	**$1,549,600**
FLOW IN 1000 GALL PER DAY								**864**
COST PER 1000 GALLONS								**$4.93**

Note: (a) Based on average daily flow

TABLE 3. GROUNDWATER TREATMENT CONTINGENCY PLAN
GAC TREATMENT SYSTEM BUDGETARY COST ESTIMATE ASSUMPTIONS
SOLUTIA KRUMMRICH, SAUGET, ILLINOIS

1	Design conditions based on the following		
	Maximum Design Flow =	1,000	gpm
	Average Design Flow =	600	gpm
	Extracted Groundwater TSS =	13	mg/L
	Extracted Groundwater TOC =	142	mg/L
2	Spare installed pumps are included in design.		
3	Budgetary estimate is based on Calgon Carbon Dual Module Systems (10 feet diameter columns), including initial fills of virgin carbon.		
4	Labor cost assumes one man coverage	8	hr/d every
		2	days for the operation period.
5	Operating labor rates are assumed to be	$40	/hr.
6	No costs are included for ANY electrical substation upgrade.		
7	Power costs assumed at	$0.046	/kWhr.
8	Maintenance costs are assumed to be	3%	of the installed equipment cost, per year.
9	Carbon usage rate assumed to be	0.10	g TOC/g carbon.
10	Carbon cost assumed to be*	$0.45	/lb for reactivated carbon delivery and spent carbon removal.
11	No taxes have been included.		
12	Land acquisition not included; sufficient existing area assumed.		
13	Electrical usage is estimated at	2	times the operating load to account for ancillary equipment.
14	An operating period is defined as	7	days/week, for 1 week

*No volume discount for carbon has been assumed for this cost estimate.

SOLUTIA

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St. Louis, Missouri 63141

P.O. Box 66760
St. Louis, Missouri 63166-6760
Tel: 314-674-1000

July 31, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Hydraulic Control Timetable
Sauget Area 2 Interim Groundwater Remedy

Dear Mr. Fayoumi,

This letter is in response to your July 10, 2003 email message requiring submission of "a time table, by which a hydraulic control will be established based on American Bottom's letter."

Enclosed with this letter is the technical memorandum "Hydraulic Control Timetable, Sauget Area 2, Sauget, Illinois which addresses your requirement.

Please call me at 314-674-6768 if you have any questions.

Sincerely,

Gary Vandiver /jk

Gary Vandiver
Project Coordinator
Solutia Inc.

cc: Sandra Bron – IEPA
Steven Acree – USEPA
Ken Bardo – USEPA
Mike Coffey - USF&W
Tim Gouger - USACE
Peter Barrett – CH2M Hill
Linda Tape – Husch & Eppenberger
Gary Vandiver - Solutia
Richard Williams - Solutia
Bruce Yare - Solutia

GROUNDWATER SERVICES, INC.

MEMORANDUM

TO: Mr. Bruce Yare, Solutia Inc.

FROM: Charles Newell and Shahla Farhat, Groundwater Services, Inc.

RE: Hydraulic Control Timetable, Sauget Area 2, Sauget, Illinois

EXECUTIVE SUMMARY

The three groundwater recovery wells for the Sauget Area 2 "Groundwater Alternative B – Physical Barrier" system will be operated without the physical barrier as an interim measure while the barrier is under construction. The MODFLOW model of the American Bottoms aquifer system was used to provide simulated hydraulic control vs. time data at four piezometer locations during this period.

Under the pumping schedule determined by the American Bottoms Regional Treatment Facility, the following differences in water elevation between the piezometers and the river were predicted 195 days after startup:

Piezometer	Assumed Location of Piezometer	(Observed Head in Piezometer) – (River Stage[1]) at 195 days)[2] (ft)
1 B	50 ft south of the planned northwest corner of the barrier wall and 30 ft inside the barrier	0.29
2 B	Directly between the north and middle recovery well	-0.26
3 B	Directly between the south and middle recovery well	-0.24
4 B	50 ft north of the planned southwest corner of the barrier wall and 30 ft inside the barrier	0.34

[1] River stage: 391 ft msl.

[2] Average of simulated piezometers in Middle and Deep Hydrogeologic Units

As shown above, the recovery system without the barrier is predicted to achieve an inward gradient in the area of the two interior piezometers, and a slight outward gradient in the area represented by the two exterior piezometers. Table 1 shows the complete hydraulic control timetable.

GROUNDWATER SERVICES, INC.

MODELING APPROACH

The MODFLOW model described in "Interim Groundwater Remedy Design Basis" (Groundwater Services, 2002) and "Impact of Inward Gradients on Barrier Wall Operating Costs" (GSI, 2003) was used as the basis for this modeling study.

The startup schedule for the pumping system, determined by the American Bottoms Regional Treatment Facility, increases from a total pumping rate of 69 gpm on day 0 to 347 gpm on day 90 to a maximum of 1042 gpm on day 180:

Time (day)	Total Pumping Rate (gpm)
0	69
30	139
60	208
90	347
120	556
150	694
180	1042

Specific storage values for these transient simulations were taken from Schicht (1965, pg. 12) where a pump test for Monsanto Chemical Company indicated a storage coefficient of 0.082 and a saturated thickness of 75 ft, giving a specific storage value of 0.00109 per ft. Specific yield was estimated to be 0.2 (Freeze and Cherry, 1979).

The analysis was performed at average Mississippi River stage, 391 ft msl.

Pumping rates were assumed to be equal for all three wells. The assumed screened intervals for each well were: 288 ft to 381 ft msl for the two outside recovery wells, and 325 to 380 ft msl for the middle recovery well.

The actual piezometers are screened throughout the entire water-bearing interval at the site. The MODFLOW model can only simulate separate piezometers in each layer in the model. For this study, the average of two simulated piezometers, (one in the Middle Hydrogeologic Unit and one in the Deep Hydrogeologic Unit) was used to provide results at the four piezometer locations.

Table 1 shows the resulting difference between the water elevation in each piezometer and the assumed average stage (391 ft msl) at 2 days; 15 days; then 15 days after each change in pumping rate shown above; and 365 days.

- C. Newell and S. Farhat

GROUNDWATER SERVICES, INC.

REFERENCES

Freeze and Cherry, 1970. Groundwater. Prentice-Hall, Englewood Cliffs, NJ.

Groundwater Services, Inc, 2002. "Interim Groundwater Remedy Design Basis", Houston, Texas, March 31, 2002.

Groundwater Services, Inc, 2002. "Impact of Inward Gradients on Barrier Wall Operating Costs", Houston, Texas, March 31, 2003.

Schicht, R.J., 1965. *Ground-Water Development in East St. Louis Area, Illinois, Report of Investigation 51*, Illinois State Water Survey, Urbana, Illinois.

GSI Job No. G-2561
Issued: 7/22/03

PRELIMINARY

GROUNDWATER SERVICES, INC.

Table 1
(OBSERVED HEADS IN PIEZOMETERS MINUS RIVER ELEVATION) VS. TIME

Hydraulic Control Timetable
Solutia Inc., Sauget Area 2, Sauget, Illinois

Time (day)	Total Pumping Rate (gpm)	(Observed Head in Piezometers - River Elevation) (ft)			
		Piezometer 1	Piezometer 2	Piezometer 3	Piezometer 4
2	69	2.07	1.96	1.87	1.89
15	69	1.63	1.53	1.47	1.51
45	139	1.26	1.14	1.10	1.18
75	208	1.06	0.92	0.89	1.01
105	347	0.88	0.67	0.65	0.85
135	556	0.68	0.38	0.37	0.68
165	694	0.55	0.17	0.17	0.56
195	1042	0.29	-0.26	-0.24	0.34
365	1042	0.20	-0.34	-0.31	0.27

NOTES:
1. Equipotential heads obtained from MODFLOW model with average river stage (391 ft msl)
2. Piezometers are located on line through pumping well locations, with one piezometer location at the north end of Site R, one midway between the north and center pumping wells, one midway between the south and center pumping wells, and one at the south end of Site R.
3. Piezometer elevations at each location taken as the average of values from two simulated piezometers located in the Middle and Deep Hydrogeologic Units in the MODFLOW model.
4. Positive values indicate piezometer has higher water elevation than river. Negative values indicate piezometer has lower water elevation than river.
5. Pumping regime: 69 gpm starts at 0 days, 139 gpm at 30 days, 208 gpm at 60 days, 347 gpm at 90 days, 556 gpm at 120 days, 694 gpm at 150 days, and 1042 gpm at 180 days.
6. The MODFLOW model assumes two fully penetrating and one partially penetrating well.
7. Simulation done with no barrier wall.
8. Initial heads taken from no-pumping, no barrier wall simulation under average river stage.
   gpm = Gallon per minute
   ft msl = Feet above mean sea level

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Solutions for a better life.

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July 31, 2003

Mr. Nabil S. Fayoumi
U. S. Environmental Protection Agency - Region 5
Superfund Division
77 West Jackson Boulevard (SR-6J)
Chicago, Illinois 60604-3590

Re: Barrier Wall Bedrock Flow
Sauget Area 2 Interim Groundwater Remedy

Dear Mr. Fayoumi,

This letter is in response to your July 15, 2003 request for an evaluation of the potential for groundwater flow in weathered bedrock beneath the barrier wall that will be constructed as part of the Sauget Area 2 Interim Groundwater Remedy.

Enclosed with this letter is the technical memorandum "Barrier Wall Bedrock Flow" which provides the information you requested.

Please call me at 314-674-6768 if you have any questions.

Sincerely,

Gary Vandiver /RL

Gary Vandiver
Project Coordinator
Solutia Inc.

cc: Sandra Bron – IEPA
Steven Acree – USEPA
Ken Bardo – USEPA
Mike Coffey - USF&W
Tim Gouger - USACE
Peter Barrett – CH2M Hill
Linda Tape – Husch & Eppenberger
Gary Vandiver - Solutia
Richard Williams - Solutia
Bruce Yare - Solutia

URS # Memorandum

Date: July 30, 2003

To: Bruce Yare

From: Steve Shroff, Tom Cooling,

cc: Bob Veenstra

Subject: **Barrier Wall Bedrock Flow**
URS Project No. 21561192

This memo addresses two key issues relating to the project; 1) a description of "weathered rock" and its excavatability, and 2) potential for flow of water below the barrier wall in the underlying bedrock.

Discussion of "Weathered Rock"

As requested, URS has prepared this discussion of the uppermost portion of the limestone bedrock unit underlying the proposed barrier wall alignment at Site R in Sauget, IL. This discussion has been based upon the boring logs completed as part of the Groundwater Migration Control System Predesign Investigation and the Sauget Area 2 Remedial Investigation, which described the uppermost surface of limestone bedrock as "weathered limestone". In this context, the term "weathered limestone" was used to describe the top 2 to 10 feet of material, which underlies the alluvial sand and gravel.

The "weathered limestone" that was retrieved during drilling activities and described on the boring logs consisted of angular limestone rock fragments that appear to range up to cobble or boulder size, in a clayey or sandy matrix. Due to the presence of the angular limestone boulders and cobbles, which are similar in appearance to the underlying competent bedrock, this material appears in core holes to be weathered bedrock. However, the origin of this material is most likely a glacial till deposited directly on the bedrock that has been scoured of loose rock by glaciation. In some borings it is a continuation of a till zone consisting of hard clay/sand/cobbles and gravel above the "weathered rock". The borings with the thickest clay zone above competent rock are generally along the northern 2/3 of the barrier wall paralleling the river. We have seen similar material (glacial till) in open cuts at the Eagleton Courthouse in downtown St. Louis. In that case, the same unit was described in test borings as weathered limestone, but in fact was a till when exposed in foundation excavations. Therefore this material directly above competent bedrock is more appropriately called "glacial till" as opposed to "weathered bedrock". Photographs, which show both the "glacial till and competent bedrock are provided in Attachment 1. As can be seen in the photographs, the competent bedrock material was relatively free of fractures, which is consistent with the presence of glacial till above the rock since glacial till would have minimized weaterhing of the bedrock.

During various subsurface investigations, the "glacial till" layer was penetrated by both conventional soil-drilling methods and direct push drilling techniques. The "Bottom of Barrier Wall" as shown in the slurry wall plans was based on the depth at which diamond core drilling was required to advance the hole in the conventional borings (SB series). In sonic borings the "Bottom of Barrier Wall" depth was taken as the depth below the zone of boulders and clay where the rock was intact. The largest direct push unit that was used during these investigations was capable of exerting a maximum of 30,000 pounds of downward force to advance the sampling tip through the subsurface. Using this direct push unit, the sampling tip was advanced approximately two to three feet into the "glacial till".

During installation of the barrier wall, a hydraulic clamshell excavator will be used to excavate the subsurface material below a depth of 85 feet, which is well above the top of the weathered bedrock. This device employees hydraulic rams, which can exert up to 90 tons of force, to close the bucket on the subsurface material being excavated. This type of tool was successfully used to remove a similar stratum at The Eagleton Courthouse project several years ago in St. Louis for which URS was the geotechnical consultant. In our opinion, this tool will excavate through the glacial till (boulder/clay zone) to competent rock as intended in the project plans.

As mentioned above, the barrier wall will be constructed through the glacial till below the alluvial aquifer and terminate on top of competent bedrock. Because of the clay content of the till, which reduces its permeability, the barrier wall will in effect be "keyed" into a low permeability zone on top of bedrock where these materials are present.

<u>Potential for Flow of Groundwater through Bedrock Below the Barrier Wall</u>

We believe that the potential for significant flow of water below the barrier wall is small for several reasons based on our experience in this area.

- The bedrock surface in this area has been scoured by the glacier to remove highly fractured and weathered rock that would tend to transmit large quantities of water.
- As noted above the rock surface is covered for portions of the wall with a clayey zone that will tend to reduce downward seepage.
- We have been involved with two major projects in downtown St. Louis where large open excavations were made into the St. Louis limestone below the water table. Prior to

construction in both cases there was major concern with encountering large open voids in the rock that would produce major ground water flows. In neither case did this happen. The first project was the excavation for the Omnimax theatre below the Gateway Arch on the riverfront. This project was done during the flood of 1993 when the river level was about 20 feet higher than the base of the excavation in rock. During that time, groundwater flow through the rock was small, less the 50 gpm (the size of the sump pump) for an excavation about 60 x 100 feet in plan with a head difference of some 20 feet. The second project was the Eagleton Courthouse in downtown St. Louis that involved a City-block-square excavation some 60 feet deep to bedrock. A concrete slurry wall keyed about 1 meter into limestone surrounded the excavation to provide lateral support and a groundwater cutoff. The resulting seepage below the wall through the rock, with about a 40-ft. head outside the wall was about 5 gpm for the entire site.

- The head difference across the barrier wall is designed to be a maximum of about 1 foot which is small and will not generate significant flow

In summary, we believe the proposed excavation equipment will reach competent bedrock and that the flow below the wall through the rock will be negligible. In addition, during construction activities, an on-site engineer or geologist will visually evaluate the excavation spoils, as they are removed from the trench, to assist in determining if competent limestone bedrock has been encountered.

Cc: Project file

URS

PHOTOGRAPHIC LOG

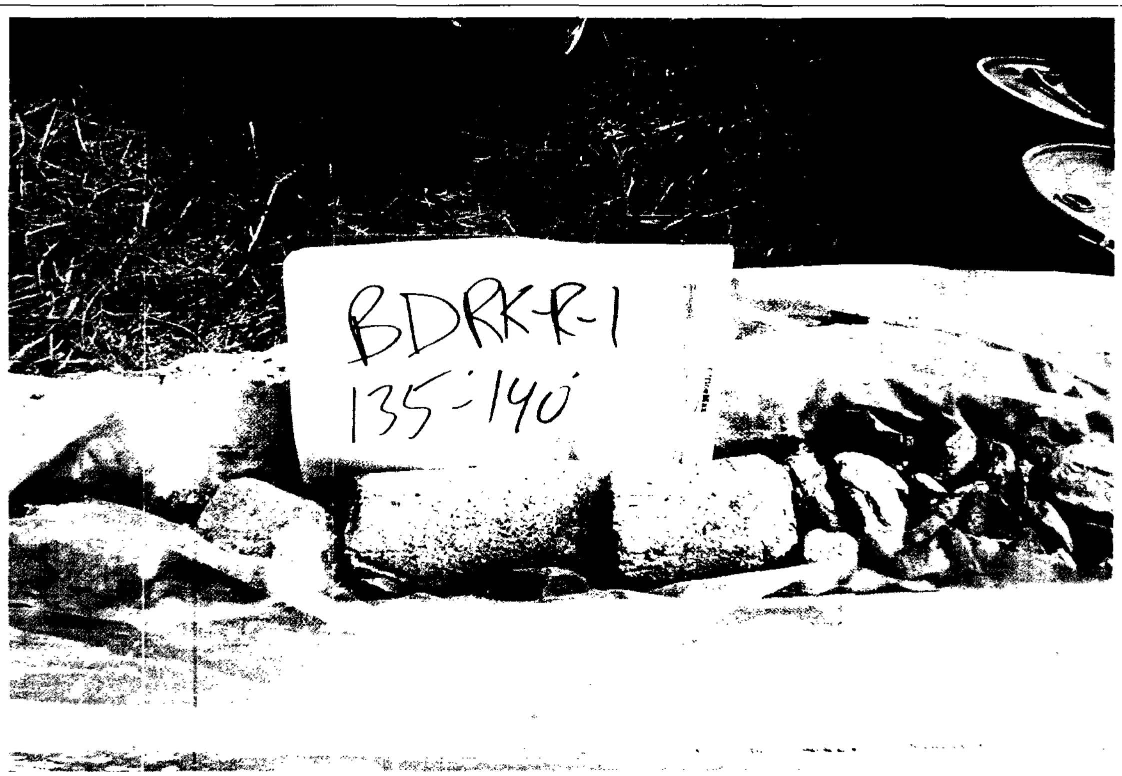
Client Name:	Site Location:	Project No.
Sauget Area 2 Group	Sauget, Illinois	21560888

Photo No.	Date:
1	7-3-02

Description:
BDRK-R-1 (115-135')

Photo No.	Date:
2	7-3-02

Description:
BDRK-R-1 (135-140')



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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Sauget Area 2 Group	Sauget, Illinois	21560888

Photo No.	Date:
3	7-3-02

Description:
BDRK-R-1 (140-150')

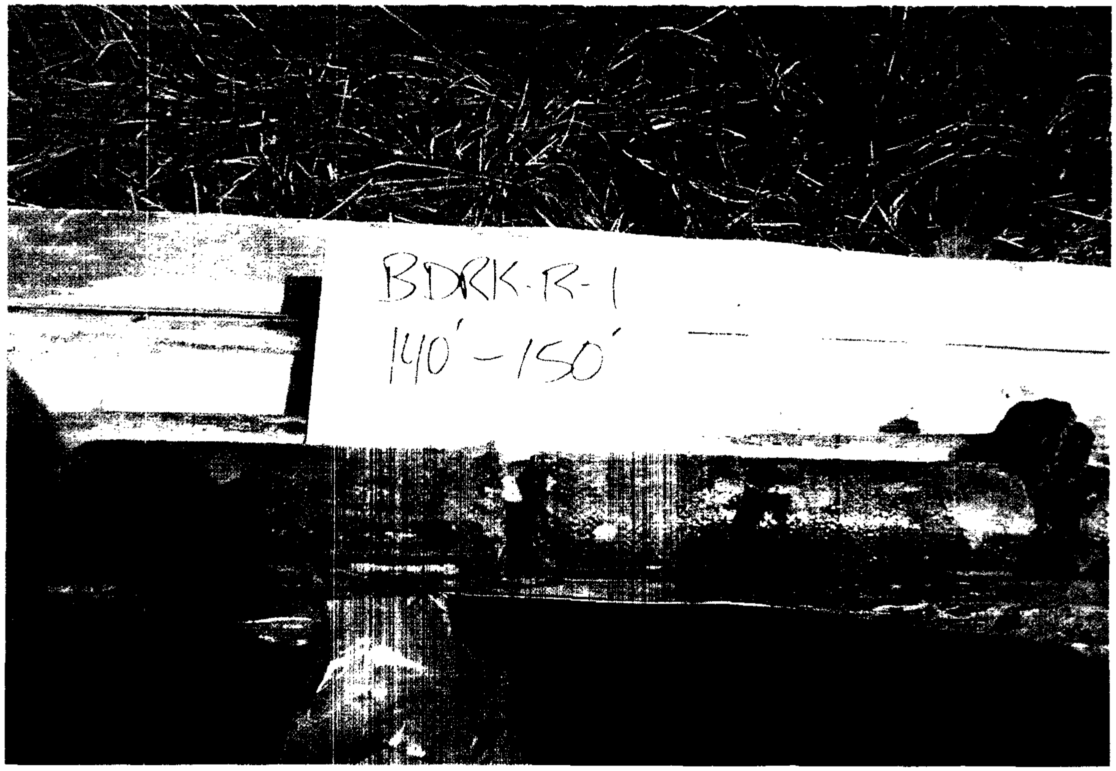
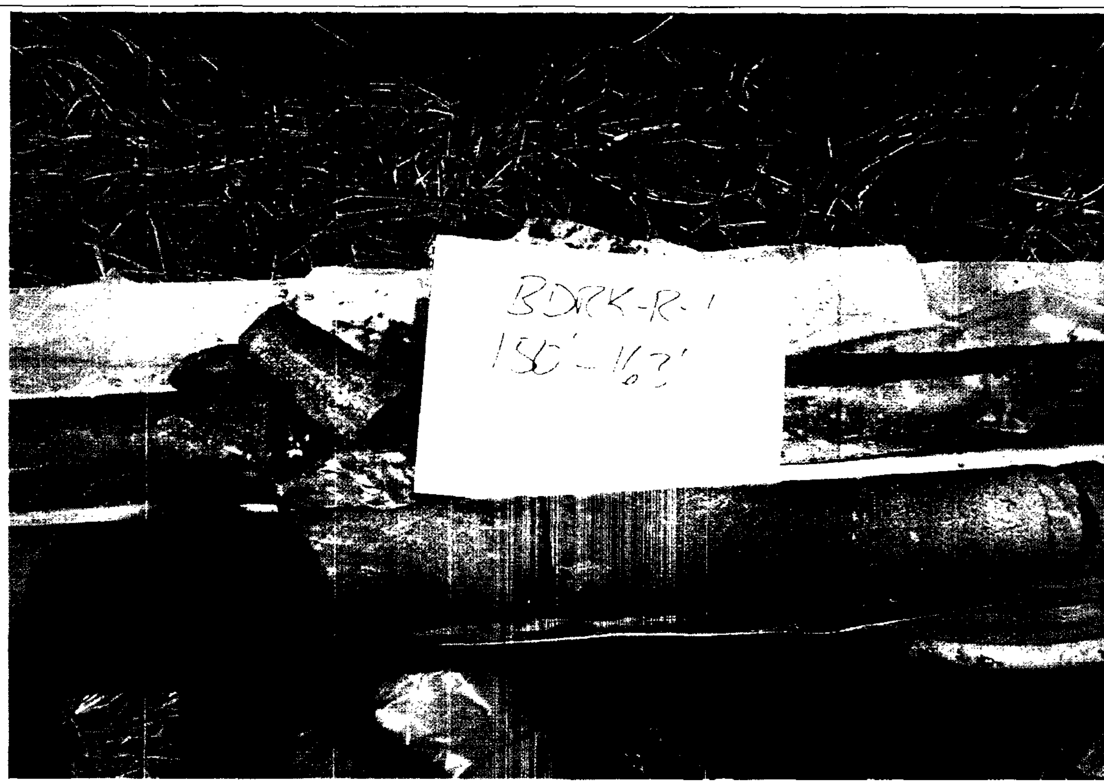


Photo No.	Date:
4	7-3-02

Description:
BDRK-R-1 (150-163')



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PHOTOGRAPHIC LOG

Client Name:	Site Location:	Project No.
Sauget Area 2 Group	Sauget, Illinois	21560888

Photo No.	Date:
5	7-3-02

Description:
BDRK-R-1 (150-163')